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SEA-WEEDS.

BY JOHN L. RUSSELL.

Once, the plants which grow in the sea were considered of no value, and therefore were called weeds; a term applied to all kinds of vegetation which interferes with the regular crops of the agriculturist. Later and better inquiry had from time to time exhibited the immense value of these sea-plants; but the term, in its odious signification, remains attached to them, as does likewise the classical name which botanically expresses this family, the Algæ of Jussieu, and the *Alga vilis* of the great and familiarly read Latin poet.

It would be impossible to state definitely the number of kinds of sea-weeds to be found in the waters of the globe, and every year adds some quite new to science, either in difference of form or else in specific points.

The Algæ belong to a vast order of plants known as flowerless; but only so, because the organs which are large and prominent in most other plants, are in these rudimentary and minute, requiring the most patient research with the microscope to detect them.

Yet notwithstanding the difficulty of finding the floral parts of these so-called flowerless plants, there are portions of the sea-weeds which bear, at certain seasons of the year,

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little bodies containing definitely formed granules which answer for seeds; and on these characters, varying in each genus, the study and arrangement of the several species to a great degree depends. It is obvious, then, that colored plates, or even dried specimens, would be of little value in determining our native species, unless something more than a mere comparison of their external aspect was made.

The sea-weeds have no roots, many float upon the surface of the ocean, and others, firmly affixed to the bottom or to stones and shells, are only anchored for security; their nourishment being derived from the atmosphere, and from the water in which they are periodically or continually immersed.

The narrow and threadlike, or it may be the broad and thickened plant, equally consists of a frond, a word derived from *frons* (Latin), meaning leaf: this frond may be simple or undivided, or cut into many coarser or finer portions, sometimes with great beauty. The color of the frond is usually either green, olive or black and red, varying in intensity, the most beautiful being the different shades of red; those with the paler tints, or with yellow and white, being partially bleached and in an incipient stage of decay.

What we notice in terrestrial vegetation as we ascend from the level of the sea to the summit of mountains, in the belts or zones of plants, certain species growing only in certain conditions of temperature, we can find reversed in the sea-weeds, the finer and more beautiful kinds growing only in deep water, and where the temperature is uniformly low and cold. Collectors of sea-weeds, accordingly, avail themselves of the dredge, or of low tides, or of fierce storms, by which latter agency the deep-water species, torn from the bottom, are cast upon the shore.

If we should visit the rocky coasts of Massachusetts, at Nahant, Swampscot, Marblehead, Cohasset, etc., etc., we should find the shallow pools made by the receding tide filled with the following kinds of Algæ, which, as some are little noticed, may be worth looking at.

Coating the surface of the wet rocks, like a short pile of green velvet, grows the *Calothrix scopulorum;* tread warily upon it lest you catch an unpleasant fall from its sliminess; it will reward you if looked at through the microscope. The surface of the rocks where it shows beneath the water is rich with crimson, owing to the *Hildenbrandtia sanguinea*, a species which I detected in company with a submarine lichen, a dark olive-green crustaceous species, the *Verrucaria mdura*, the former being unknown to Professor Harvey as a North American plant when he published his Nereis Boreali-Americana, which describes our sea-weeds. In similar tide-pools I found, at Marblehead near the fort, the singular *Peysonella orbicularis;* and on smooth pebbles under the water, circular patches of a pale-pink crust, which are the *Melobesia*. These, cut with a sharp knife into very thin slices across the warts which rise from the surface of the patches, will show, when magnified, the seeds lodged in minute cavities and the cellular structure of the frond. Lining the sides of these basins are the pretty coral sea-weeds, which fade so soon after drying, once thought to be, and described by Lamaroux, as animals, but now known as lime-bearing sea-weeds (*Corallina officinalis*), the actual frond being covered with a calcareous crust, which the plant has extracted and secreted from the sea. Throw a tuft of it into some diluted muriatic acid, the plant within will be revealed! The seed-vessels are elegantly formed, urn-shaped, but closed caskets, on the very tips of the branches.

Here also grow the glossy green *Cladomorpha*, and the fistulous, swollen *Enteromorpha*, both of many kinds; and where the water is brackish, like the broad overflowed ditches on the salt-marsh in rear of the beach, may be seen in vast floating masses, smooth and slimy, or bullate and bladdery, of a pale yellow-green tint in the sun, and white and like paper when lying dry and dead on the grass, the *Conferva flavescens*, which, taken up by the winds and

transported far into the interior, as once in Europe, was collected on falling in a rain-tempest, and deposited in some royal museum as meteoric paper! Rising with stiff, bristly, and sharp-pointed and jointed dark-green filaments, may be seen, in the deeper and colder tide-pools, the *Chætomorpha melangonium*, looking rich and inviting to the eye; and, lining the bottom, may be detected the dwarfer forms of the Carrageen, or *Chondrus crispus*, and its relative and neighbor the *Gigartina mammillosa*, with its channelled, forked, lobed frond, the segments often covered with tubercules, the color a rich dark purple, becoming, like the carrageen, of the same horny stiffness when dry. Sometimes among the rocks, but oftener lying upon the soft mud, are the beautiful shining smooth green *Ulvæ*, or Laver, of which there are two or three kinds; the seeds are to be looked for in the very substance of the fronds, arranged in fours; one, the *U. latissima*, or oyster-green, grows upon the shells of oysters, and may be frequently seen on piles of living oysters in the market. Served with lemon-juice, it is employed as a salad, and esteemed by the Chinese as salubrious. Hanging on piles and piers in a flaccid, drooping way when the tide is out, but bravely flaunting its gay, rich purple banners to the rushing and incoming return of the sea, is the *Porphyra*, or purple Alga, which I have seen finely luxuriant at East Boston ferry dock, and elsewhere.

A most interesting order of the sea-weeds is the SIPHONACEÆ: green, or else coated with lime, the fronds very variable in form, but made up of hollow, inarticulate filaments, belonging to our warmer seas, but represented in the little feathery *Bryopsis plumosa*, found near Quincy, and given me by my friend, Miss Brewer, of Boston,—something worth looking after on the narrow leaves of the sea-wrack, or Zostera.

The ribbon leaves of this plant, familiarly known as Eel-grass, is often prettily speckled with small patches of a hard thin scale, of an irregular outline. Any one of them care-

fully detached from the leaf, and magnified five hundred diameters, will show a specimen of rare elegance, a sort of shell-like body with three or more lobes, and regularly made up of a great many, somewhat square cells. It is the *Hapalidium phyllactidium* of Kutzing, detected by me a few years ago, and till then new to our flora, but discovered first by Professor Allman in Dublin bay, Ireland.

On the perpendicular faces of the larger rocks, and completely covering the rounded and erratic ones near the beaches, and also on the stone-walls and piles of the wharves, grow the several *Fuci*, whose seeds are to be searched for late in the autumn and on the beginning of winter, lodged in rounded imbedded cells, and of much beauty. The Fuci have a wide geographical distribution, growing very far towards the north pole, and known quite far southwards. According to Professor Harvey the deficiency of species is a very marked feature in our coasts, two only, the *vesiculosus* and *nodosus*, or the bladder and the knotted fuci occurring, and these quite limited in range. It were somewhat rash to differ from such high authority, yet it seems to me more than probable that some of the other European representatives, such as *serratus*, for instance, may be found; and small forms which grow on the hard and compact gravel at high-water mark, which always remind me of *caniculatus:* in confirmation of which a few specimens of fuci, collected and named by Desor in 1850, near Boston, and presented me by my friend, Miss H. B. Stevenson, are now lying before me, indicating an agreement in the same direction. Rising and falling in the surf as it dashes against the rocks, these species seem instinct with sensitive life, and appear to shake themselves in the cool water as if refreshed after partial desiccation and lassitude, while shoals of the smaller fishes and crustaceans dart in and out in security among their exuberant tresses.

To this order belongs the interesting Gulf-weed (*Sargassum*), one species of which floats in vast beds around the

island of Nantucket, and on the yielding surface of which may be seen the blue-eyed Peeten, the common scallop of our coasts, skipping along by opening and closing its valves. I have never met with any kind of gulf-weed in our waters, but some are found on the shores of Rhode Island, of which a beautiful and delicate species was discovered by the late and distinguished Professor Bailey, and dedicated to the great French botanist, Montagne.

Somewhat resembling it is the *Cystoseira*, a genus belonging to the European seas, and "scarcely represented in the New World," the *expansa* being detected in California, more delicate in its character, the frond much divided, the branches so converted into air-vessels, or vesicles, as to look like strings of beads. Here also belongs the Sea-thong (*Himanthalia lorea*), a marvellous plant, which at first grows like a cup, and which expansion is in reality its frond, and when ready to bear seed, throws out from its centre several branching linear straps, which extend from ten to twenty feet in length, although only less than an inch wide. It must be sought for at the very lowest tides, or by the dredge, and although attributed to the coast of North America by Agardh, has hitherto escaped the observation of our botanists.

In such situations, and even at greater depths, occurs the *Desmarestia aculeata*, in long tufted bundles of a dark olive-green color, usually gathered and preserved in its autumnal and winter form, when it loses the delicate and fresh growth it had in warm weather; so different, that it is often considered two distinct species. It may be known by its spine-like branchlets, although soft and yielding when moist. From these profounder deeps are dragged by the storms the huge kelps, Tangle or Devil's-apron, the *Laminaria*, looking like some oar with its stem and blade, and often attached to a large pebble of many pounds weight, clinging with its grasping fingers, or bearing in its embrace a huge mussel, on which it had grown. This really noble plant,

rising upwards from the bottom of the sea to the altitude of twenty feet or more, typifies those gigantic sea-weeds of the North-western coast, which, in the instance of the *Nereocystis*, has a stem three hundred feet long; or the still larger *Macrocystis* of the Southern Pacific, whose fronds, according to Bory St. Vincent, stretch to a length of fifteen hundred feet! Grander these than any forest tree on mountain or plain, in tropical and luxuriant terrestrial vegetation!

Turning from these, and often lying close by among the heaped waifs from the stormy ocean, the inquirer may see the curious Sea-colander (*Agarum Turneri*), with its tenderer and thinner frond, pierced with numerous roundish holes, and growing, when undisturbed, at the depth of ten fathoms of water; in this single species exhibiting on our coast one of the many kinds peculiar to the Northern Atlantic and Pacific shores. To find its seeds one must select the old and battered specimens cast up in early winter, in the thickened portions of which they form dark-colored patches. Quite distinct, but of the same order, the slender Whiplash or Fishing-line fucus, the *Chorda filum*, lays entangled among the rejectamenta, a simple cylindrical tubular frond, transversely divided into separate cavities, the seeds embedded in the whole exterior surface; and the Honeyware, Murlins or Badderlocks of the shores of Scotland and Ireland, is the *Alaria esculenta*, the midrib of which is eaten by the poorer classes of those countries, but here unnoticed or disregarded, though not uncommon on our coasts.

Some rarer sea-weeds, comprised in the order DICTYOTACEÆ, may be looked for in the tide-pools, though usually of a more southern habitat, such as the Dot-bearer (*Stilophora*), the seeds being imbedded in little punctiform dots, which internally are made up of bead-like, clavate, branching filaments; the frond cylindrical, imperfectly tubular, branched; while *Dictyosiphon* has a bristly frond, very much branched, the branches capillary, the seeds solitary, a pretty olive-colored "weed;" and, in allusion to these seed-dots, we are

reminded of the *Punctaria tenuissima*, to be sought on the stems of various other fuci and sea-plants, in dense tufts, the fronds very thin and attenuated towards the tips and base. Still, among the olive-colored Algæ, the order CHORDARIACEÆ embraces many distinct sea-weeds with gelatinous or cartilaginous fronds, whose seeds are concealed within the substance of the frond, of which the *Chordaria* and *Mesogloia*, with conspicuous cylindrical fronds, and *Elachista*, or the Least Alga, consisting of little tufts of minute brown fronds parasitical on the common rock-weeds, or fuci, and the Myriad-thread, or *Myrionema*, which hastens the death of the Red Algæ, are worth the looking for microscopical study.

In the tide-pools grow also the sea-weeds which compose the order ECTOCARPACEÆ; and on our shores are *Ectocarpus brachiatus*, and perhaps *littoralis*, pretty confervoid, branching flaccid algæ with numerous pod-like bodies, readily seen with a lens; the *Sphacelaria cirrhosa*, a small species in little globose tufts, the thread-like branches slightly branched again in a pinnate manner, the seeds in round capsules borne on the sides of these smaller and shorter branches, to be examined with the magnifying glass; and, lastly, the *Cladostephus verticillatus*, with fronds six or eight inches high, and furnished with whorls of smaller branches closely besetting the main stems, and giving them the appearance of cylindrical wands of velvet surface, while the seeds are borne on the sides of the smaller branches like those of the last mentioned.

Enough has been said, then, of the green and olive or blackish sea-weeds, a few words of the red or purple ones:

First are the RHODOMELACEÆ, red or brown-red and purple sea-weeds, with leafy, or else with threadlike articulated fronds, the seeds of two kinds, the proper ones borne in capsules on the ends of the branchlets; the others, called *tetraspores*, in tubercules on the sides or other parts of the fronds. These sea-weeds are fond of a more southern ocean and latitude, but in this vicinity *Chondria tenuissima*, the

most delicate of the genus, may be sought; and several *Rhodomelæ*, very beautiful, blackish-red, feathery, and tufted sea-weeds beside, not forgetting the *Polysiphoniæ* of many forms and sizes, the most common, perhaps, and to me the most interesting, being the blackish one, which grows in tufts on fuci, the *P. fastigiata;* others, far more delicate and of more pleasing colors, likewise occur with us; and with them the *Bostrychia rivulsari* also southern in its habits as a genus, and the beautiful *Dasya*, more at home farther south, is often met with in collections of Algæ gathered hereabouts, *D. Elegans* being one of the comparatively sparse Algæ on the sandy shores of Nantucket.

In the order LAWRENCIACEÆ the fronds are terete or compressed, rarely flattened, the seeds contained in external globose conceptacles, the tetraspores immersed in various parts of the frond. There is much diversity in the color of the several species; usually, however, a lurid purple is the typical one, fading on exposure to the light, and parting with it readily on being immersed in fresh water. The *Laurencias*, on which the order is founded, are southern, but *Champia* occurs at Providence, R. I., at Nantucket, and New York, and may be sought as a parasitical plant farther north.

The SPHÆROCOCCOIDEÆ embrace a vast number of very interesting sea-weeds, mostly resident in tropical and foreign seas. I know of none whose structure has interested me more, and if any species occur to the reader on our shores, in the few which may be sought here, they will afford rare gratification with the microscope, their internal structure varying as much as the outward forms. Some of the finest and most brilliant weeds are to be found, a few only are of a duller tint. The seeds are lodged in elegantly formed conceptacles, which are filled with beaded filaments, on the apices of which the seeds are situated; the tetraspores are in definite groups, or else dispersed over the whole fronds.

The DELESSERIÆ have rosy-red, leaf-like, branched, jag-

ged, delicately membranaceous, symmetrical fronds, with a midrib running through the middle of each. They grow in deep water, and several species are found in Massachusetts Bay. By far the most beautiful of them is *D. Americana*, lately dedicated to Henry Grinnell, Esq., conspicuous in his efforts to find Sir John Franklin; and its generic name, derived from his own, was given by Professor Harvey in his Nereis Boreali Americana, some distinctive structure in the seed-vessel being detected by that botanist. The *Grinnellia* being so abundant in New York harbor, may be sought among our Delesserias.

The GELIDIACEÆ, like the last order, is also tropical or mostly foreign. One or two species occur with us, such as *Gelidium corneum*, a most variable plant, with a forked, branched and pinnately divided frond, of a purplish-red, soon changing color, especially if immersed in fresh water, and finally parting with it altogether, but retaining a glossy or waxy lustre when completely bleached.

A rather singular Alga, found in our waters for the first time perhaps, by George B. Emerson, Esq., is the *Polyides rotundus*, a single genus of a single species, and constituting the order SPONGIOCARPEÆ, the seeds of which are found in irregularly shaped warts extending along the branches, of a pale flesh-color, wholly composed of slender, branched filaments, like those of the bark, or cortex, of the frond; the tetraspores are formed in the upper branches deeply immersed.

Passing over several other Algæ too rare on our coast for notice, or else already adverted to, we come to the order RHODYMENIACEÆ, purplish or blood-red sea-weeds, with inarticulate, flat, compressed, or filiform membranaceous fronds, the seeds lodged in external conceptacles. Among these to be sought is *Rhodymenia palmata*, with a frond six to eight inches long, and four to six inches broad, wedge-shaped at base, cut downwards into several slender ribbons, but sometimes quite simple; the *Euthora cristata*, with a

fan-shaped frond, excessively branched, the color a beautiful lake; the *Plocamium coccineum*, very beautiful and frequently overlooked, but occurring among the cast-up weeds of the sea,—a deep-water species.

Other elegant rosy or red sea-weeds, belonging to still other orders, are more or less common in our bay, of which the *Phyllophora membranifolia*, the *Ahnfeltia plicata*, *Cystoclonium purpurascens*, of which there is a curious variety, the ends of the smaller branches being converted in spirally twisted tendrils, which coil round other sea-weeds: the *Gigartina mammillosa*, already alluded to, with the *Chondrus crispus*, of which many singular forms may be seen in the same pools; the *Chylocladia*, reminding us of Bailey, in a new species; the *Gloiosiphonia capillaris*, a single species, limited to the northern seas of Europe and America, of a brilliant carmine color and very much branched, found at Nahant, Hampton Beach, Chelsea, etc., and why not hereabouts? the *Spyridia filamentosa*, a genus better known in warmer seas; the *Ceramiaceæ*, with numerous delicate rosy and reddish species in *Ceramium rubrum* and its varied forms, in *C. diaphanum*, *fastigiatum* and *arachnoideum* perhaps; in *Ptilota plumra*, beautiful and common, and in its kindred Californian species *P. densa*, etc.; in the rarer *P. serrata* occurring with us; in *Griffithsia*, a beautiful and slender Alga, of a soft gelatinous substance, closely adhering to paper; in the numerous *Callithaminons*, minute, elegant, and curious, some of them parasitical, and all puzzling to decide, many of which the seeker can find on our sea-shores.

So much for the sea-weeds, and for the smaller portion of the interest attached to them, reminding us in their fine names of the glories of the ocean, of its cooling breezes, its fitful aspect, its crested foam and blue surface in rest and repose, sought for eagerly by many a weary and tired citizen, and affording perpetual instruction and pleasure to the naturalist, and in its floral as zoölogical treasures a constant source of study to all.

A STROLL BY THE SEA-SIDE.

BY EDWARD S. MORSE.

THE sea-side naturalist has certain advantages not possessed by his inland *confrère*, in the greater variety of life, and in the profusion of material which is daily exposed to him by the tides, and in the debris strewn in windrows along the shores by the heavy storms that sweep along the coast. While he may turn inland and in an hour's walk reach the representatives of animals which are found throughout the continent, the inland naturalist must visit the sea-side to see the living representatives of certain classes that are almost, or quite exclusively, marine.

Even a whole branch of animals, the Radiates, comprising such animals as the sea-anemones, jelly-fishes, star-fishes, and sea-urchins, has only one feeble microscopic representative in fresh water. The class of bivalve mollusca, with its unique sea forms of razor-clam, mussel, scallop, and hundreds of others, is represented in our fresh-water ponds and streams, by the mussels and a few minute forms, though it may be said with truth that the mussels of the Western waters ape in their variety of forms, many of the marine species. The entire class of Cephalopods, comprising the squid, cuttle-fish, and nautilus, is exclusively marine. The extensive class of Crustacea, with the lobster, crab, and shrimp as common examples, are represented in fresh water by the crawfish and a few smaller species. As a slight compensation, however, the inland student has oftentimes stored up in the rocks beneath his feet imperishable mementos of ancient sea-life, and he may there find gigantic ammonites, huge masses of coral, and thousands of other forms remotely similar to existing species in the ocean.

The godsend to an inland collector of a drained canal, or the exposed bottom of a pond after a drought, is daily repeated on the sea-side by the recedence of the tide, leaving

hundreds of miniature aquaria in the crevices of the rocks, freshly stocked and daily replenished by nature, while the surrounding conditions, in the form of clean rocks dried by the sun, the absence of foliage to obstruct the light, offer the collector every opportunity to study the marvels of sea-life in their native haunts. Thus, while the sea-side offers unrivalled attractions to the tourist, it opens to the naturalist a field for study as vast as the sea itself.

Let us take advantage of a day at the sea-side, by a stroll along the shore between high and low-water mark, and jot down a few observations on the more common forms that are sure to meet the eye at every turn. And first of all we notice the rocks whitened as if by a painter's brush. All the exposed ledges, as far as the eye can reach, reflect the rays of the sun like snow-drifts. Can it be possible that this limy covering is made up of little sentient animals, whose soft bodies moisten the rocks, as we crush them by hundreds at every step?

We examine them, and yet no signs of life are seen; closely they remain locked up in their shelly casements. Yet in a neighboring pool of water we see these tiny animals with their doors thrown wide open, and a little crown of feelers flung out in constant action. And this motion is incessantly repeated, making a movement like the grasp of a human hand in space. These animals are known as Barnacles (Plate 6, figs. 1, 2). They not only clothe the rocks in summer, but form an almost impenetrable coat of mail around the piles of our piers, and by their rapid growth foul the ship's bottom at sea.

A closer inspection of this animal with a lens reveals the fact, that the appendages thrown out so actively are lined with little hairs; that the mouth is situated within the shell at the base of these appendages, and that the clutching motion is made to secure the minute particles of food that float in the water, which are swept toward the mouth and secured by it. One hardly wearies of watching the rhythmical and

graceful movements of these never-tiring appendages, and the curious movements of the mouth-parts, as some invisible tit-bit is secured by its perpetual industry.

For a long time these animals were included in the same branch with the clams and snails, until it was discovered, by observing the young stages of the barnacles, that they were more closely allied to the crabs and shrimps, that is, articulated animals, and that they had no relationship with the shell-fish so called. It was found that the young barnacle (Plate 6, fig. 3) was furnished with jointed appendages, having also organs of sight, and that in this condition swam freely in every direction; that finally securing a hold upon some body, it became cemented head downward, lost forever the power of locomotion and the organ of sight, secreted a hard shell around it, and then for the rest of its life, became dependent on the sustenance brought to it by the inflowing tide. We can thus account for the stunted growth of those individuals which have unwittingly effected a lodgment near high-water mark, for in thus securing eligible house-lots, they are left helpless, and imprisoned most of the day, with the scorching rays of the sun to parch their tender bodies, in place of the cool wash of the waves. Fig. 3*a* represents the young barnacles directly after attachment; fig. 2, another species of barnacle in a state of rest.

In the same pool we notice another strange form, partially concealed by the floating tresses of sea-weed that form so luxuriant a growth of plant-life along the coast. This animal, for it really is an animal, though apparently growing from the rock like a plant, is called the Sea-anemone, or Actinia (Plate 6, fig. 4). A crown of many tentacles, outstretched like the petals of a flower, spring from a leathery cylindrical body, which is affixed by a broad base to the rock. Very little movement is manifested by the animal till we irritate it, when the tentacles slowly unfold till they disappear within the body, leaving only a warty excrescence in place of the beautiful expanded flower (Plate 6, fig. 5).

Waiting patiently a few moments, the tentacles slowly reappear. Noticing the expanded part more attentively, a small slit is seen in the centre of the exposed disk, and surrounded by the tentacles; this is the mouth, and for a proof of it we have only to drop a bit of meat, so that it may fall within the radius of the expanded tentacles, and as it comes in contact with them, is immediately seized, not only by the tentacles against which the meat strikes, but by others that promptly swing in that direction. The tentacles are covered with minute cells, from which threads dart and adhere to their prey. These cells produce a distinct nettling sensation upon the hands of some that are brought in contact with them, and appear to paralyze the living objects upon which they feed. The tentacles appear glued to the meat, and by this power of adhesion rather than that of grasping, the food is passed from one set to the other until it is brought to the mouth, which yawns gradually, and into which it finally sinks. Another bit shares the same fate, even if it is dropped upon the extreme verge of the tentacular crown, and very amusing it is to watch their quaint manœuvres when fed in this way. A small pebble, or other substance not appropriate for food, is instantly rejected. Thus, in this interesting experiment, animality and the power to discover by touch proper substances for food are manifested. The organization of the animal is extremely simple; a cylindrical body having only one proper opening which answers the purposes of mouth and vent; this orifice leading to a sac-like stomach hanging within the body. Also within the body numerous vertical radiating partitions, corresponding to the tentacles that project from the crown, comprises the prominent parts of its structure. An English writer states that "foreigners boil many kinds of Actiniæ for the table, and find them a very pleasant dish. The texture is something like calf's-foot jelly; taste and smell resembling that of crab or lobster. Eaten with sauce, they are savory."

To those who can never conceive a reason for the creation of an animal unless it is either good to eat, offers a remedial agent, or can quickly be converted into money, we add the following receipt for cooking them, from "Devonshire Rambles," by Phillip H. Gosse: "As it was an experiment, I did not choose to commit my pet-morsels to the servants, but took the saucepan in my own hand. As I had no information as to how long they required boiling, I had to find it out for myself. Some I put into cold water (sea-water), and allowed to boil gradually. As soon as the water boiled, I tried one; it was tough and evidently undone. The next I took out after three minutes' boiling; this was better; and one at five minutes was better still, but not so good as the one which had boiled ten. I then put the remaining ones into boiling water, and let them boil ten minutes, and these were the best of all, and more tender as well as more inviting in appearance. I must confess that the first bit I essayed caused a sort of lumpy feeling in my throat, as if a sentinel guarded the way, and said, 'It shan't come here.' This sensation, however, I felt unworthy of a philosopher, for there was nothing really repugnant in the taste. As soon as I had got one that seemed well cooked, I invited Mrs. G. to share the feast; she courageously attacked the morsel, but I am compelled to confess it could not pass the vestibule; the sentinel was one too many for her. My little boy, however, voted that 'tinny was good,' and that 'he liked tinny,' and loudly demanded more, like another Oliver Twist. As for me, I proved the truth of the adage, '*Ce n'est que le premier pas qui coûte;*' for after the first defeat my sentinel was cowed. I left little in the dish." After this he fried them in egg and butter-crumbs, and "all prejudice yielded to their inviting odour and appearance, and the whole table joined the repast with evident gusto."

Space will not allow us to mention at this time the many interesting features regarding its peculiar modes of development, though we may add that the coral insect, so called, is

nothing like an insect whatsoever, but is included in the same class of animals with the sea-anemone, from which it does not depart in any material point of its structure, except that the coral animal deposits lime in its growth, while the sea-anemone does not.

On the moist rocks and wet sea-weed we notice numerous little snails, some of them round, about the size of a pea, dark brown or dingy yellow in color. Dropping some of them into our dish of sea-water, we observe their movements plainly. A little soft-bodied animal, slug-like, with two feelers or tentacles thrust out ahead, having at their base a pair of little black eyes, and between the feelers a roundish trunk like an elephant's proboscis, only very short. This they apply closely to the surface upon which they rest. The mouth opens at the end of this snout. A little tongue within the mouth, furnished with numerous minute hooks, keeps up a continual lapping movement, rasping off the minute vegetation upon which they feed. Looking through the glass jar in which they may be kept, we not only notice the motions of the tongue, but the manner in which they crawl, moving first one side and then the other of the disk-like foot, which seems to be divided by a longitudinal furrow. Notice how gracefully they twirl the shell in their movements. Taking a few in our hand, they quickly withdraw within their shells, and, as they disappear, a lid, called the operculum, which is attached to the tail, closes the aperture effectually. Nearly all of the marine snails, and many of the land and fresh-water snails likewise, are furnished with this operculum.

The eye-stone, so-called, is nothing more than the operculum of some tropical snail; for the opercula of our northern snails are mostly of a horny nature, very few species having calcareous opercula.

The species we have just described is called *Littorina palliata*. Their habits are such that they require a submergence in the sea-water of only a few hours each day. For

this reason one will find them oftentimes in abundance near high-water mark. When kept in an aquarium, they are continually crawling up the sides of the vessel, and out of it completely. Plate 6, figs. 6, 7, represent the shell and animal.

The common Cockle (*Purpura lapillus*), Plate 6, figs. 8, 9, is another very common species on our coast, and a very interesting collection can be made by selecting the different varieties of the shell. Some of the shells are quite solid, and either white in color, or variously banded with brown or yellow; now and then a specimen is found of a rich yellow; others are quite thin and delicate, with the outside covered with little scales, or imbrications. The animal is white, and the operculum is a rich brown or reddish.

This species is carnivorous in its propensities, and with its sharp rasp-like tongue, will drill the neatest round holes in the shells of other species, and through the hole thus made devour the contents. The empty shells of the cockle's victims, or of other carnivorous species, may always be recognized by the little countersunk hole in the shell. The mussel seems to be a favorite food of the cockle. It has been ascertained that it requires two days for the cockle to drill through the shell of the mussel, and, after the animal dies from this rude treatment, the shell gapes open, and the cockle then feeds upon the soft parts within, through the natural opening. The eggs are laid in little oblong yellow-colored capsules, which they deposit in clusters on the rocks (Plate 6, fig. 9*a*). Each little capsule contains from sixteen to thirty young, which eat their way out through the cases when fully developed. The cockle was supposed to be the species from which the celebrated Tyrian purple was obtained. At all events, there is a coloring matter extracted from the living animals, which is at first yellowish, but after exposure to the sun's rays, will gradually change, passing through various shades of green and violet, then to a purple, and finally to a crimson. It is often used for bait in fishing

for cunners, or perch, and the fingers become stained a deep purple after handling the crushed animals.

In the crevices of the rocks, and in certain pools left by the tide, we shall find the common salt-water mussel (Plate 6, fig. 10) closely compacted in great numbers. On attempting to detach a specimen from the rocks, it is found that they are held in place by a strand of little silken threads, issuing between the valves of the shell, and adhering strongly to the rock. This bunch of threads is called the byssus, and a tropical genus, called Pinna, produces a byssus of considerable size. Gloves have been woven from the fibres composing it. The individuals covered by water display at the free end of the shell and between the valves (each shell of a bivalve is termed a valve, hence the name *bivalve*, two valves), which are partly open, two openings formed by the mantle. These openings are scarcely divided; one opening reaching nearly to the byssus is beautifully fringed with little arborescent fringes, the other opening is plain. If we watch the particles floating near these openings, it will be seen that a current of water is passing in at the fringed opening, while from the simple opening a current of water is as constantly issuing. These currents of water are produced by the vibration of little moving hairs, or cilia, which line the membranes within. The gills, of which the animal has four, two on each side, are particularly covered by the cilia, so that if the shell is broken open, and a piece of the gill is separated from the animal, it will swim round in the water like an independent animal for some time. We become acquainted with an excellent provision in this arrangement, for in the first place the currents of water kept up in this way bring a continual supply of fresh sea-water to the gills, and in the second place the food of the mussel, which is mostly of an infusorial character, is brought to the mouth by the same means. The two short openings we have seen in the mussel, in other genera like the clam are prolonged into two long tubes covered by one sheath, or form two distinct tubes as in certain other genera.

In contemplating the many complete provisions made for these lower animals in procuring their food, one is led to admire the adaptability of ciliary motion which appears to take so prominent a part in the functions of the lower animals. Among the lowest forms of life, locomotion is effected entirely by ciliary motion; among others, food is brought within the compass of their mouth, and the gills are continually bathed with fresh water. Generative products are brought together for the impregnation of the eggs. The new-born animal is borne safely to some place of attachment, or to a proper position for future growth.

A large and ponderous mussel, called the Horse-mussel, may be torn out from the crevices of the rock just at low-water mark, and the roots of the large sea-weed, commonly called the "devil's apron," are often found entwined around specimens of this species. While speaking of this gigantic sea-weed, we may say that after storms, and in fact at nearly all times, this Laminaria, as it is technically termed, may be found on the shores, and the collector must never fail to examine carefully every portion of it for novelties. On the broad crenulated brown frond he will find certain species of snails browsing. On the stem, patches of calcarious growth, looking like the most delicate lace, may be seen; strange as it may appear, each little cell, composing this lace-work, is occupied by a tiny animal, whose true relations are with the clams and oysters. In the tangled roots, the collector often reaps a rich harvest of marine worms, brittle starfishes, minute crustaceans, and many other animals. The reason why this sea-plant affords such an interesting field for the collector is, that it comes from beyond low-water mark. In the sea, as on the land, there are different zones of animal and plant-life. Thus on the land we find in low places certain species of plants and trees; a little higher we have the hard-wood growths; on the mountain slopes the pines and spruces flourish, while near the tops of our highest mountains lichens only can exist, and at the highest elevations the bare rocks alone meet the eye.

So in the sea, between high and low-water mark is an assemblage of animals and plants peculiar to that area, and this is called the littoral zone; from low-water mark to about fifteen fathoms another group of plants and animals are found, and as the Laminaria grows to profusion in this zone, it is called the laminarian zone. Below this we have the coralline zone, and deep sea-coral zone. Many animals range through all these zones, but there is a sufficient number of species restricted to each, which give each zone a determinate character. Thus the Laminaria is an envoy from another zone, coming laden with the animals and plants peculiar to its zone. As we are confining ourselves to those forms that are abundant between high and low-water mark, we must reluctantly leave for another time the treasures that this sea-weed possesses.

The common starfish, or five-finger jack (Plate 6, fig. 11), is one of the abundant forms under rocks at low-water mark. By throwing back the masses of sea-weed that conceal the rocks near the water's edge, they may be found of all sizes, and of every shade of brick-red, crimson, and purple. How fast they cling as we attempt to pluck them from the rocks, and by examining the underside of the fingers, or arms, we notice rows of suckers, that look like so many worms twisting and writhing in every direction! Dropping one into a dish of sea-water, we soon see the admirable use that is made of these suckers, for now they act like so many little legs. These suckers are enabled to project some little distance from the animal, and by these the animal is carried from one place to another. How gently they glide over the uneven surface of the rock, each sucker in turn reaching in advance and securing a hold, and, after contracting and thus pulling the body along, relaxing for a new start! Perhaps by diligent search you may capture a starfish at his dinner, and a strange way he has of eating it. Mussels, beach-cockles, and shell-fish, form the favorite food of the starfish.

Having selected one for his meal, our starfish arches his body over the shell, grasping it at the same time with its arms, and then, marvellous to relate, puts its stomach out of its mouth and enfolds the shell with its lobes. Whether the stomach secretes a poisonous fluid is not known, at any rate the victim dies under the effects of this warm embrace, the shell flies open, and the starfish devours its contents.

In the young starfish the eyes can be plainly seen, five in number, one at the end of each ray or arm, shining like little garnets. In the older ones it is quite difficult to distinguish them.

The starfish often loses one or more of its rays from having them bitten off by hungry fishes, or perhaps crushed off by crabs when young. Nature, however, restores them again, for new rays bud in the place of those lost, and it is not uncommon to find specimens that have lost all but one ray, with the four new rays just commencing to grow. Others may be found with three large ones, and two small ones, and a variety of forms, resulting from this renovating power after mutilation, may be gathered among the rocks.

Another curious starfish, called the brittle starfish (Plate 6, fig. 12), is found in the pools at extreme low-water mark. It takes its name from the fact that it is extremely brittle, the arms falling to pieces when roughly handled. In this species the arms appear quite independent of the disk, not merging into it as the species previously described. These arms, moreover, have greater freedom of motion. Though they have no true suckers, the arms are covered with spines, and, having great mobility, they twist and turn in every direction, and are quite active when compared to the common "five finger."

We have referred to their brittle nature, but another species, belonging to the same family, occurring on the English coast, has for its specific name "fragilissima," on account of its extreme fragility. Edward Forbes has given an amusing account of his endeavors to capture this species, and we pre-

sent it here: "The first time I ever caught one of these creatures, I succeeded in getting it into the boat entire. Never having seen one before, and quite unconscious of its suicidal powers, I spread it out on a rowing-bench, the better to admire its form and colors. On attempting to remove it for preservation, to my horror and disappointment I found only an assemblage of rejected members. My conservative endeavors were all neutralized by its destructive exertions, and it is now badly represented in my cabinet by an armless disk and diskless arm. Next time I went to dredge on the same spot, and, determined not to be cheated out of a specimen in such a way a second time, I brought with me a bucket of cold fresh-water, to which article starfishes have a great antipathy. As I expected, a *Luidia* came up in the dredge, a most gorgeous specimen. As it does not generally break up before it is raised above the surface of the sea, cautiously and anxiously I sank my bucket to a level with the dredge's mouth, and proceeded in the most gentle manner to introduce *Luidia* to the purer element. Whether the cold air was too much for him, or the sight of the bucket too terrific, I know not, but, in a moment, he proceeded to dissolve his corporation, and at every mesh of the dredge his fragments were seen escaping. In despair I grasped at the largest, and brought up the extremity of an arm with its terminating eye, the spinous eyelid of which opened and closed with something exceedingly like a wink of derision."

While parting carefully the floating masses of sea-weed in search for other novelties, our attention is attracted by the unusual movements of a large shell, commonly called the whelk. As the customary movements of nearly all mollusks are slow and sluggish, we are the more surprised at these movements. We at once secure the shell, and are rather confounded to find it a bleached and sea-worn specimen, with no traces of its original inhabitant within. We drop it upon the rocks, and directly out comes a singular-looking

crab, not quite out, for he retains a hold upon the shell and drags it alertly after him. We have found the Hermit-crab (Plate 6, fig. 13), called by some the Soldier-crab on account of its extreme pugnacity, and receiving the first name, because, like a hermit, it lives alone in its shelly house.

The species belonging to this genus are remarkable for the singular softness of the hinder portion of the body; this is rather long, and is coiled on itself. To protect this soft part, that would otherwise be nipped off by some hungry fish, the crab resorts to some empty shell, and, inserting his tail into the aperture, makes it his home, and carries it about with him in all his perigrinations.

The hermit-crab, like other members of the class Crustacea, increase in size through a process called "moulting." The hardened crust outside does not grow. It is only a hardened skin, as it were. Now as the body within increases in size, the outside shell must be thrown off, to allow the enlargement of the animal. This throwing off of the outside crust is called *moulting*, and takes place at certain times. With the crabs, lobsters, and others, the animal appears to fast for some time, retires to a secluded nook in the rocks, and there awaits the cracking open of its well-worn coat. This crack takes place along the back, and through this opening the animal draws itself. After it comes forth its skin is soft and tender, and some time is required before it is sufficiently hardened to enable it again to successfully battle with its enemies.

Our hermit-crab has still another stage to go through after moulting, for when this process has taken place, it finds its coiled shell too small for it, and must go on that tiresome search, called house-hunting. Back and forth it travels on the beach, surveying with critical acumen the tenantless shells on the beach. Here it meets one altogether too large, and an amusing sight it is to see it drag its soft and helpless tail from the shell, to try another one on to see if it fits. Sometimes it meets with a shell that is apparently just the thing,

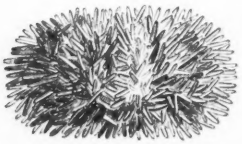
but unluckily it is already occupied by a brother hermit. A freebooter is our hermit, and so without any apologies it proceeds by force to eject the tenant. A fight ensues, and oftentimes ends in the ejectment and mutilation of one or the other. Perhaps the name Soldier-crab is more appropriate, from its belligerent character. Gosse has described one of these fights, from which we subjoin the following: "The Soldiers (as indeed becomes their profession) are well known to be pugnacious and impudent, yet watchful and cautious. Indeed, their manners and disposition, no less than their appearance, bear the strongest resemblance to those of spiders. Two of them can scarcely approach each other without manifestations of hostility; each warily stretches out his long feet and feels the other, just as spiders do, and strives to find an opportunity of seizing his opponent in some tender part with his own strong claws. Generally they are satisfied with the proofs afforded of mutual prowess, and each, finding the other armed at all points, retires; but not unseldom a regular passage of arms ensues; the claws are rapidly thrown about, widely gaping and threatening, and the combatants roll over and over in the tussle. Sometimes, however, the aggressive spirit is more decided and ferocious. One in the aquarium of the Zoölogical Gardens was seen to approach another, who tenanted a shell somewhat larger than his own, and, suddenly seizing his victim's front with his powerful claw, drag him like lightning from his house, into which the aggressor as swiftly inserts his own body, leaving the miserable sufferer struggling in the agonies of death."

The reader must bear in mind that we have only touched upon the more common forms to be met with on the coast, and that without the least difficulty he may find a legion of others, equally as interesting, and readily preserved alive in sea-water for a considerable time. He will do well to carry away with him a pailful of these animals, with a generous supply of sea-water in which to immerse them. The numerous sea-worms, of which we have not spoken, will repay

him a careful hunt. A common worm on the coast he will find in the guise of a coiled white shell, firmly cemented to a bit of sea-weed or other substance. Sometimes a frond of sea-weed will be whitened with them. They are quite small, and to examine them properly will require the assistance of a lens. The head is surrounded by numerous little appendages, which answer the purpose of gills. One of the appendages is thickened and rounded at the end, and serves as a plug to the aperture of the shell, when the animal retires.

Fig. 14, plate 6, represents an enlarged figure of this worm, with the animal protruding, and the adjoining figure shows a bit of sea-weed, with several of the worms drawn to the natural size.

The adjoining cut represents the appearance of an animal quite abundant at low tide, commonly called the *Sea-urchin*. It is covered with a great many long sharp spines, and in addition to these spines, there are five zones of suckers passing from the mouth, which is below, to the opposite pole of the body. These suckers perform locomotive functions, as do the suckers of the starfish described above, and the collector will be repaid in watching the movements of the animal alive. The sea-urchin, when dead and bleached upon the beach, forms a very curious object. A flattened, spherical shell, composed of a large number of small plates, all neatly fitting together; five zones of these plates perforated for the passage of the suckers, and all the plates ornamented with minute rounded protuberances upon which the spines were attached, make up the empty shell of the sea-urchin. We may briefly add, that the collector will find in the piles of dried sea-weed rolled up by the waves, many curious objects all prepared and dried by the sea and the sun. If on the long beaches, he will find many interesting shells, dried



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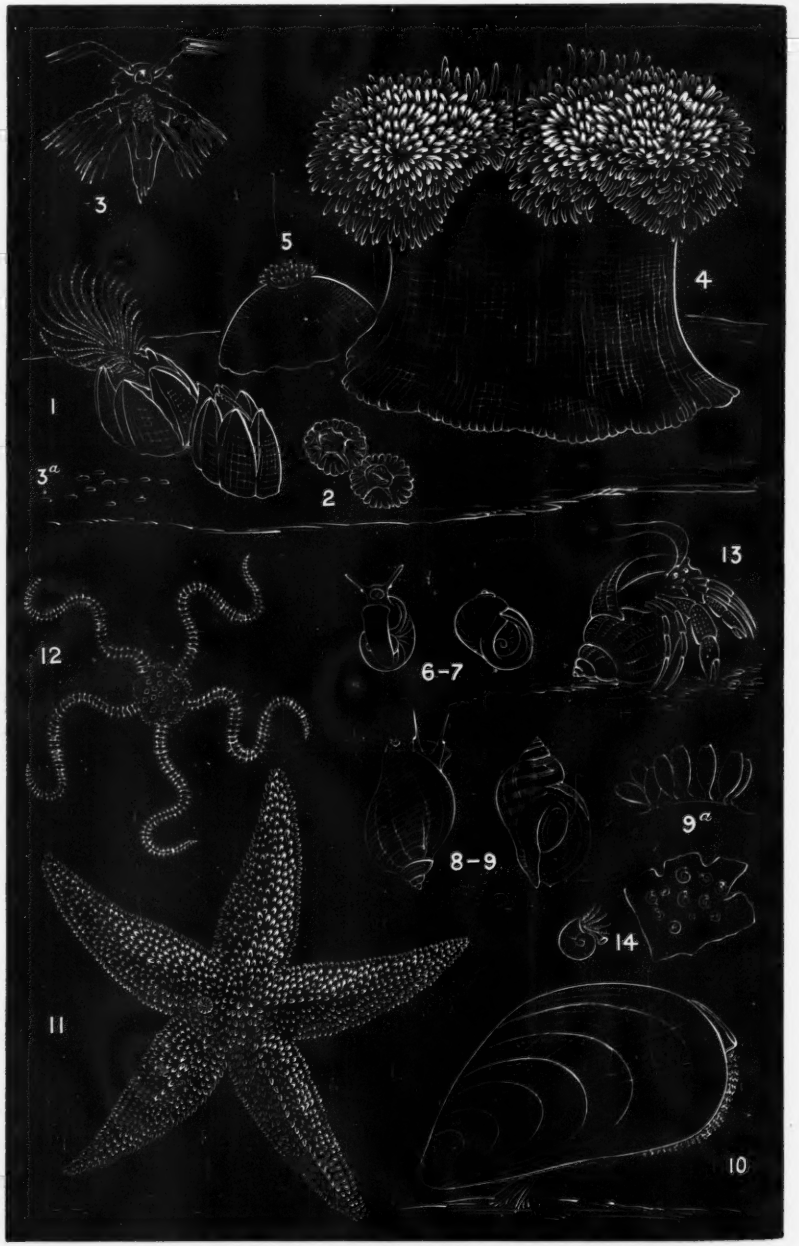
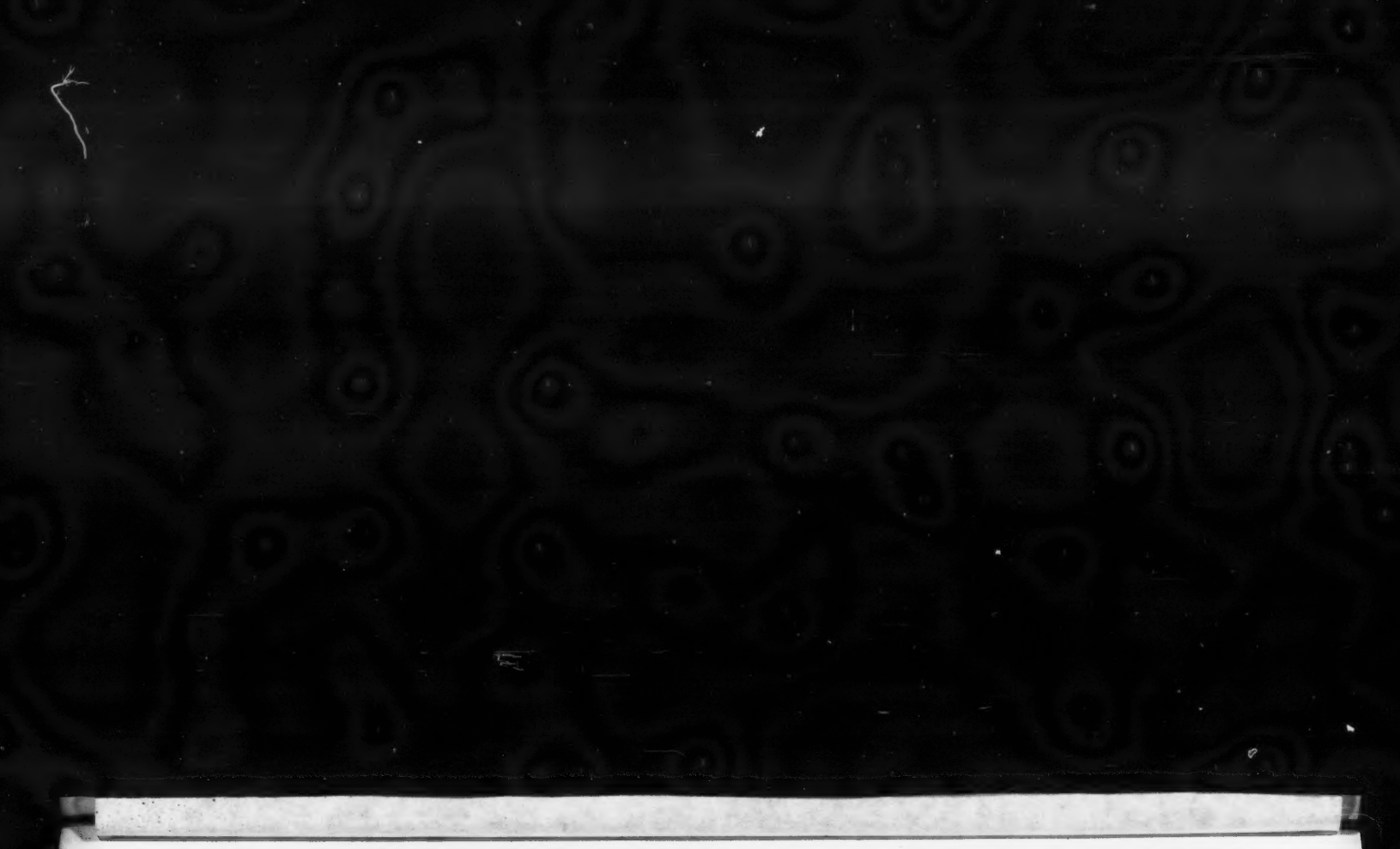


MORSE ON THE COMMON ANIMALS OF THE SEA-SHORE.



crabs, empty shells of sea-urchins, and oftentimes many objects that are really worth preserving for cabinet specimens.

EXPLANATION OF PLATE 6.

Fig. 1. Common Barnacles, *Balanus eburneus* of Gould.
Fig. 2. " " " *ovularis* "
Fig. 3. Free swimming young of Barnacle.
Fig. 3*a*. Young Barnacle directly after attachment.
Fig. 4. Sea-anemone expanded, *Metridium marginatum*.
Fig. 5. " contracted,
Figs. 6, 7. Periwinkle, *Littorina palliata*.
Figs. 8, 9. Cockle, *Purpura lapillus*.
Fig. 9*a*. Egg-cases of the same.
Fig. 10. Mussel, *Mytilus edulis*.
Fig. 11. Starfish, *Asterias vulgaris*.
Fig. 12. Brittle Starfish, *Ophiopholis bellis*.
Fig. 13. Hermit-crab, *Bernhardus longicarpus*.
Fig. 14. *Spirorbis nautiloides*.

OUR SEA-ANEMONES.

BY A. E. VERRILL.

To all frequenters of the sea-shore during the summer months who take pleasure in seeking and studying the many wonderful and beautiful inhabitants of the ocean, the modest and retiring Sea-anemones cannot fail to offer many attractions; and there are few marine creatures that can so easily be reconciled to the narrow limits of an aquarium, and so readily become permanently established in their new home. Thus they afford us every opportunity to study their habits and structure, and to watch their ever-varying forms and beautiful colors. But to see them in their perfection one must visit them in their native haunts in some cool, rocky pool, overhung with projecting ledges and drooping seaweeds, or in some deep grotto among the shattered cliffs, half-illumined by the sunbeams which struggle for entrance

through the cool sea-weeds that hang from the rocky roof dripping with salt dew. In such favorite retreats the *Fringed Sea-anemones** (Plate 6, figs. 4, 5) make their home and rear their numerous families, year after year, until every nook and crevice is fully occupied, and even the entire floor is completely carpeted by their soft, delicate tufts of tentacles. In such localities it is common to see specimens of every variety of hue, from pure white, pink, salmon, chestnut, orange, yellow, and light-brown, to dark-umber; while others will be mottled or variously striped with two or more colors. These colors, however, are those of the outer wall of the body. But the upper part of the body and the innumerable tentacles have lighter and more delicate tints, and this, combined with their translucent texture, gives to the summit of the body and its broad crown of fine tentacles a peculiarly graceful appearance, which is much increased by the numerous deep frills into which the tentacle-crowned margin of the disk is always thrown in the large specimens. The tentacles are also frequently banded with white. It is always difficult to decide which specimen in one of these numerous colonies is most beautiful when all are so attractive. But the pure white ones most frequently suffer for their beauty, and are borne away in triumph to new homes, which, perchance, prove in the end less happy and pleasant to them than the home of their youth.

The Fringed Sea-anemone is not found exclusively in such places as described, but may be found on almost any rocky or ledgy shore along the coast of New England, and in fact from New York to Labrador, snugly ensconced in the crevices between boulders, or on their under surfaces, wherever there is sufficient space to expand their tentacles, and complete shade from the sun's heat. For although these lowly

* *Metridium marginatum* Edw. and H. For a more complete description, see "A Revision of the Polyps of the Eastern Coast of the United States," by A. E. Verrill, in Memoirs of the Boston Society of Natural History, Vol. I. For other descriptions and figures, see "Sea-side Studies in Natural History," by E. C. and A. Agassiz, and Tenney's Zoölogy.

organized creatures have no eyes, nor even nerves, they are very sensitive to strong light, and love the shade. They may also, at times, be found clinging to the piles of wharves, and on small stones and shells, wholly unprotected. Near Mount Desert Island, I once saw, during a very low tide, a large surface of rocky bottom so completely covered by them, that the foot could not be put down without crushing many noble specimens. A single stone, the size of a man's head, taken from this place, was found to be the residence of sixty individuals, of all sizes. They sometimes occur at a greater depth than twenty-five fathoms, but are frequently found between high and low-water mark, both in pools and in places where they are left dry for an hour or more, where they hang relaxed and flabby until the tide returns, when they quickly revive. To remove large specimens of this species from their favorite rock, without serious injury, is no easy matter; for although they are not permanently attached, but are capable of moving freely about by gliding along upon their large, highly muscular, adhesive base, yet when disturbed they cling so closely and firmly to the rock, that they are very liable to be torn open upon the base, rather than loosen their hold. But if the rock be tolerably smooth, by gradually and carefully starting them up by pushing with the thumb-nail or some dull instrument against and under the base, they may finally be safely removed. If broken open they will never recover or heal, though they will usually expand and appear very well for several days.

In the confinement of an aquarium, or even in a jar or bowl of sea-water, one of these Actinias will soon make itself at home, and, fixing itself upon one side of the vessel by its base, will expand its feathery plume of tentacles day after day in search of tiny prey, and woe to the unlucky creature, be it animalcule, shell-fish, shrimp, or fish, that comes in contact with its crown of gorgon-tentacles, armed with myriads of poison-darts, deadly to all creatures destined to be its prey! When fully expanded, this species has

a very graceful form, which cannot fail to please any one who has a taste for the symmetry and beauty of natural objects. From the slightly expanded base the body arises in the form of a tall, smooth column, sometimes cylindrical, sometimes tapering slightly to the middle, and then enlarging to the summit. Towards the top the column is surrounded by a circular, thickened fold, above which the character of the surface suddenly changes, the skin becoming thinner and translucent, so that the internal radiating partitions are visible through it. This part expands upward toward the margin, which is folded into several deep undulations or frills, and these edges are covered everywhere by an immense number of fine, slender, crowded tentacles, which also occupy about half the width of the oral disk, but increase in size and diminish in number toward the mouth, which occupies the centre of the disk. The mouth is oval, and its lips have numerous folds. It opens directly into the stomach, which is a simple sac suspended in the centre of the body, having a small opening in its lower end, through which the products of digestion are poured into the main cavity of the body, while the hard or undigested parts of the food, such as shells, bones, etc., are cast out from the mouth. The whole interior of the body, between the stomach and exterior, is divided up into an immense number of narrow chambers, by thin muscular partitions, which radiate from the centre toward the exterior, and are of various widths, some reaching from the wall to the stomach and serving to support it, while others extend only a little way inward from the outer wall; each tentacle is hollow and is a direct continuation of the radiating chamber below it, so that there are as many chambers as tentacles, and, of course, twice as many radiating partitions as chambers. The digested food, mingled with sea-water, serves for blood, and fills all the chambers and the main cavity of the body below the stomach; and, as there is no heart, this fluid is put in motion and circulated through every part by means of

myriads of minute vibrating lashes, or *cilia*, that cover all parts of the interior surface, and this same surface of soft membrane has the power of absorbing such nutritious substances as each organ may require, from the fluid that bathes it, and also the oxygen contained in the sea-water. Indeed it is probable that every part of the surface, both external and internal, has the power of absorbing oxygen; but it is reasonable to conclude, that this takes place most rapidly in the tentacles and internal membranes where the structure is most delicate.

We usually notice, when trying to remove one of these Actinias from its rock, a large number of white, thread-like organs, emerging both from the mouth and from minute openings through the sides of the body. These organs appear to be for the defence of the creature, since they are found to be composed almost entirely of minute poison-darts, or lasso-cells, arranged side by side, and having a deadly stinging power when used against small animals. In fact there are very few of the predacious marine animals, even not excepting the voracious fishes, that have the temerity to attack one of the harmless-looking Sea-anemones; for though their darts may not have sufficient power to kill a large fish, they will, at least, penetrate the thin membranes of the mouth and produce a severe stinging, like that of nettles. And since these stinging threads may be thrown out copiously, and are several inches long, they are very effectual organs of defence. The inner ends of the threads are attached to the free edges of the radiating partitions, and the free ends are thrown out simply by the contractions of the animal, and consequent expulsion of the fluid contained in its body, which, as it rushes out of the mouth and through the loop-holes of the sides, carries with it the threads. When the Actinia is again left in repose, it gradually draws in its stinging threads. The little poison-darts, usually called lasso-cells, which cover both these threads and the tentacles, have a wonderful structure for organs so minute. They

consist of little vesicles or cells filled with fluid, and have a very long, extremely thin tube, coiled up in the interior. This tube is continuous with one end of the vesicle that contains it, so that when the vesicle is compressed or contracted the fluid forces out the tubular dart by turning it inside out, as one would turn the finger of a glove. The slender tube, when thrust out, is very long, slender, and pointed, and usually curiously and wonderfully barbed. The nature of the poison, so deadly to small animals, which these darts emit when they penetrate the flesh, is still unknown; but whatever its nature, it must be very powerful, for the quantity is necessarily excessively small. The tentacles not only capture and kill the prey by means of these organs, but by means of the darts, that thus penetrate in large numbers, they hold it firmly until conveyed from the tentacles to the mouth. Among our native Sea-anemones there are no species that have darts powerful enough to sting the hand, though some species, like the Star-anemone, will often adhere so firmly, if its tentacles be touched by the finger, that it may be lifted from the water before it will loosen its hold. This adherence is doubtless due to the many lasso-cells that partially penetrate the epidermis, or outer layer of the skin, but have not power to enter far enough to reach the sensitive portion. But the common, large, red Jelly-fish (*Cyanea arctica*) has similar poison-darts covering its long, floating, thread-like tentacles, which are powerful enough to penetrate the human skin, and sting far more painfully than nettles. And among the coral reefs of Florida and the West Indies, there are corals (*Millepora*) which, unlike most corals, have animals belonging to the same class with the Jelly-fishes, and their tentacles have poison-darts, which, according to the observations of Professor Hartt, sting the parts of the hands where the skin is most delicate very severely. The same is true of some other *Hydroids*, which do not form coral, but grow in moss-like tufts. It is also said that some of the foreign Sea-anemones have the same power of stinging

the hands, and especially those of persons having a delicate skin. But certainly no such charge has ever been brought against any of our native species.

The Fringed-anemone makes a very pleasing pet in confinement, and, if allowed plenty of room and fresh sea-water, will expand almost constantly. It feeds readily upon the flesh of all sorts of shell-fish, etc., and will not refuse bits of raw beef. And if necessity compels, it will live for months, or even a year, without food; but, curiously enough, it will continually grow smaller and smaller, so that a specimen, at first five or six inches high and two in diameter, may thus be reduced to the height of an inch, and the diameter of less than half an inch, the number of tentacles and chambers being proportionately reduced. In fact, under such circumstances, the animal seems to undergo a retrograde process, exactly the reverse of that by which it originally developed from youth to maturity.

The ovaries of Actinias, and all similar animals, including the coral-polyps, are attached to the inner edges of the radiating partitions below the stomach, and are filled with immense numbers of eggs, which are discharged, when mature, directly into the fluid filling the body, and then are either discharged very soon from the mouth, or are retained for a longer or shorter time, until they are hatched into miniature Actinias, which are discharged in different stages of development and of various sizes; but however small they may be, they are perfectly competent to take care of themselves from the first. The Fringed-anemone, and some other kinds, when they remove from places where they have long been stationary, are liable to tear off and leave behind them little fragments from the edge of the base, but every one of these fragments will in a few days develop a little mouth and a row of tentacles around it, and will soon become a perfect little Actinia, differing only in size from its parent. The same effect may be obtained at will by cutting off little portions from the edge of the base with a sharp knife. This

process is evidently analogous to the wonderful powers of restoration and development of mutilated and lost parts, so well known by experiments upon the fresh-water *Hydra* and other low animals, some of which may be cut up in every direction into many pieces, and each part will still restore all the parts that are lacking. It has, also, some analogy to the process of budding, so common among the coral-polyps.

The *Star Sea-anemone** is another beautiful and interesting species, which may readily be domesticated in an aquarium, and proves very hardy in confinement. This species, instead of having a smooth body like the preceding, is covered with little wart-like pustules, arranged in vertical rows, which have the power of adhering firmly to foreign substances, such as bits of shell and sea-weed, with which it often so completely covers its body as to effectually conceal itself, when contracted into a low cone among the rocks and gravel where it often dwells. But when it lives, as it frequently does near Eastport and about the rocky shores of the neighboring islands in the Bay of Fundy, in fissures and cavities of ledges, overhung and protected by sea-weed, it usually discards its foreign covering, which now becoming no longer useful, is evidently regarded as a burden. When placed in an aquarium, even if covered with foreign matters, it very soon discards them and appears perfectly clean. The uppermost pustule of each row is larger than the others, and forms an inflated vesicle just below each tentacle. The tentacles, instead of being very small and numerous, as in the Fringed-anemone, are comparatively few, rarely more than seventy-two in the largest specimens, but they are large and often more than an inch long. The mouth usually has the form of a cross, with several prominent folds upon its lips. Its body is usually pale, translucent, olive-green, sometimes approaching flesh-color, and the disk and tentacles have a lighter tint of the same colors, while the tentacles are con-

* *Bunodes stella* Verrill. Memoirs of the Boston Society of Natural History, Vol. I, p. 16, Plate I, figs. 1 to 8. Also a figure copied in Tenney's Zoölogy.

spicuously banded with opaque-white, and upon the disk there are usually six or twelve white lines, radiating from the mouth to the bases of the tentacles. Most of the tentacles usually have a white, heart-shaped spot upon the inner side of their bases. This pretty Actinia is very common at Eastport and vicinity, and has been found at Cape Elizabeth, Maine. In the latter locality the specimens were half-buried in sand at the bottom of a rocky pool near low-water mark. Doubtless it will be found upon all parts of the rocky coast of Maine. In confinement it expands most freely in the evening. It feeds, like the other species, upon all sorts of mollusca and crustacea that come within its reach. It brings forth living young, often of considerable size, which emerge at irregular intervals from the mouth, sometimes singly, sometimes in large numbers. It does not grow so large as the preceding, the body seldom becoming more than two inches high and one in diameter, but having more than twice that diameter across the expanded tentacles.

The *Red Sea-anemone** is unquestionably the most beautifully colored and showy of all our northern Actinias; but, although very changeable in shape, it lacks the elegant forms assumed by other species. The body usually forms, in expansion, a low cylinder, broader than high, with a broad disk, surrounded by a moderate number of large, rather short, tapering or blunt tentacles. The exterior of the body is sometimes nearly smooth, but at other times shows a few, rather inconspicuous, warts or suckers scattered over the surface. The colors are extremely variable. The shore specimens are mostly irregularly mottled with deep brownish red, and dull greenish, while the tentacles are pinkish, banded with opaque-white. The disk is often light-greenish or pink, with radiating lines of purple or

* *Rhodactinia Davisii* Agassiz. For full descriptions see the Memoirs Boston Society above quoted, and for a figure, "Sea-side Studies," p. 13, fig. 10. This species belongs to the "sub-genus" *Urticina* of Ehrenberg, and as that is an earlier name, it should be called *Urticina Davisii*, until it be settled whether it be really distinct from *U. crassicornis* of Europe.

deep red, which embrace the bases of the tentacles. Occasionally shore specimens are found having the body uniformly bright red, crimson, or pink, with a lighter-colored disk and tentacles. The tentacles are usually banded with white in all varieties, but are sometimes uniform pink and translucent. Other specimens often have the body pink, mottled with orange-red, or blotched with crimson. The specimens from deep water have generally brighter and clearer colors than those of the shore, but are quite as commonly found mottled with two or more shades of red, as of uniform red or pink colors. The habits of this fine Actinia are much like those of the last, and the young are produced in the same manner. It attains a much greater size, for specimens are not uncommon which are two inches high and four or five in diameter when expanded. The large specimens, however, are apt to be troublesome inmates of an aquarium, on account of their remarkable voracity, for nothing seems to come amiss to them. They will capture and swallow fishes of considerable size, as well as crabs, mollusks, etc., and even have been known to swallow the spiny sea-urchins of considerable size. Other Actinias, even, are not safe in their neighborhood. Such large specimens also have a singular habit of frequently protruding the stomach, and even turning it wrong side out, as if affected with nausea, which certainly adds nothing to their beauty. But specimens of small or medium sizes make very interesting pets, and are often more beautifully colored than the large ones.

In Massachusetts Bay this species is seldom found except by dredging, when it usually comes up adhering to stones and dead shells. It inhabits all depths down to forty fathoms at least. At Eastport, Grand Menan, and other islands at the mouth of the Bay of Fundy, where the enormous tides leave exposed, at low-water, a wide zone, unusual facilities are afforded for obtaining all sorts of rare and curious marine productions, which, on other parts of the coast, can be

obtained only by dredging in deep water. On these shores the two large *Solasters*, or Starfishes, with ten or twelve rays and beautiful colors, together with several other rare Starfishes, the Daisy Serpent Star,* the many-armed Basket Fish,† several large and curious Holothurians, the elegant Alcyonium, the much-sought Terebratula, many curious and beautiful Ascidians, among which the Cynthia,‡ or "Sea Peach," is one of the finest, and a great variety of rare shells, may all be obtained at low-water, during the extreme tides, together with a great abundance of the three Actinias above described. The Red, like the Star Sea-anemone, loves best the fissures and crevices of the rocks and ledges, that are thickly overgrown with fuci and other sea-weeds, which furnish a complete protection to the animals nestling among the rocks. Even among the lofty wharves of Eastport there are ledges in the crevices of which hundreds of these Anemones may be found.

The *White-armed Sea-anemone*,§ unlike the three preceding species, is as yet unknown except along the southern coasts of New England, upon the shores of Long Island Sound, and near New York City. This Actinia is more nearly related to the Fringed-anemone than to the others, and like that has slender tentacles, and loop-holes along the sides of the body, out of which threads of stinging darts issue, which are lacking in the two last species. But this is a smaller and more delicate kind, seldom growing more than three inches high and one in diameter, and the tentacles are much longer and not so numerous. The body is of the same texture from base to summit, and the edge of the disk is not thrown into undulations, or "frilled." Its colors are usually light-yellowish, or flesh-colored, and translucent, while the tentacles are usually white. It lives most commonly at-

* *Ophiopholis bellis* Lyman. Plate 6, fig. 12.

† *Astrophyton Agassizii* Stimpson.

‡ *Cynthia pyriformis* Rathke.

§ *Sagartia leucolena* Verrill. Proceedings of Boston Society of Natural History, Vol. X, p. 536. 1866.

tached to the under side of boulders that have a cavity beneath them, and is well adapted to the aquarium, where it very soon becomes perfectly at home, and expands almost constantly. Inhabiting the same region with this there is another more rare species of *Sagartia*,* which is duller in color and less graceful in form, which lives buried up to its tentacles in gravel.

Besides the species already described, there are several others that are less conspicuous, which inhabit the New England coast, several of which live buried in sand or mud, like many worms, and only protrude their tentacles at the surface. These kinds are usually long and slender, and taper at the base instead of having a flat adhesive disk. Farther southward on the Carolina coast there are several other peculiar species, some of them beautifully colored, and also several species of true corals, the animals of which closely resemble the Sea-anemones in structure and habits. One pretty species of coral† is even found on the southern coast of New England. This is found just below low-water mark, encrusting stones and shells, and forming little irregular masses of coral, covered with star-like cells or cups, which are about an eighth of an inch across. The polyps, which in life rise above these stellate cups, are colorless and almost transparent, resembling, in nearly all respects, miniature Actinias. This coral lives well in confinement, and feeds readily upon bits of oyster, in the same manner as the Sea-anemones.

THE MARINE AQUARIUM.

Buy at any glass-shop a cylindrical glass jar, some six inches in diameter and ten high, which will cost you from three to four shillings; wash it clean, and fill it with clean

* *Sagartia modesta* Verrill. Described with the preceding species.
† *Astrangia Danæ* Agassiz.

salt-water, dipped out of any pool among the rocks, only looking first to see that there is no dead fish or other evil matter in the said pool, and that no stream from the land runs into it. If you choose to take the trouble to dip up the water over a boat's side, so much the better.

So much for your vase; now to stock it. Go down at low spring-tide to the nearest ledge of rocks, and with a hammer and chisel chip off a few pieces of stone covered with growing sea-weed. Avoid the common and coarser kinds (fuci) which cover the surface of rocks; for they give out under water a slime which will foul your tank; but choose the more delicate species which fringe the edges of every pool at low-water mark; the pink coralline, the dark purple ragged dulse (*Rhodymenia*), the Carrageen moss (*Chondrus*), and, above all, the commonest of all, the delicate green Ulva, which you will see growing everywhere in wrinkled fan-shaped sheets, as thin as the finest silver paper. The smallest bits of stone are sufficient, provided the sea-weeds have hold of them; for they have no real roots, but adhere by a small disk, deriving no nourishment from the rock, but only from the water. Take care, meanwhile, that there be as little as possible on the stone beside the weed itself. Especially scrape off any small sponges, and see that no worms have made their twining tubes of sand among the weed-stems; if they have, drag them out, for they will surely die, and as surely spoil all by sulphuretted hydrogen, blackness, and evil smells.

Put your weeds into your tank, and settle them at the bottom, which last some say should be covered with a layer of pebbles; but let the beginner leave it as bare as possible, for the pebbles only tempt cross-grained annelids to crawl under them, die, and spoil all by decaying; whereas if the bottom of the vase is bare, you can see a sickly or dead inhabitant at once, and take him out (which you must do) instantly. Let your weeds stand quietly in the vase a day or two before you put in any live animals; and even then, do

not put any in if the water does not appear perfectly clear; but lift out the weeds, and renew the water ere you replace them.

Now for the live-stock. In the crannies of every rock you will find sea-anemones (*Actiniæ*); and a dozen of these only will be enough to convert your little vase into the most brilliant of living flower-gardens. There they hang upon the underside of the ledges, apparently mere rounded lumps of jelly; one is of a dark purple, dotted with green; another of a rich chocolate; another of a delicate olive; another sienna-yellow; another all but white. Take them from their rock; you can do it easily by slipping under them your finger-nail, or the edge of a pewter spoon. Take care to tear the sucking base as little as possible (though a small rent they will darn for themselves in a few days, easily enough), and drop them into a basket of wet sea-weed; when you get home, turn them out into a dish full of water and leave them for the night, and go to look at them to-morrow. What a change! The dull lumps of jelly have taken root and flowered during the night, and your dish is filled from side to side with a bouquet of chrysanthemums.

Let your Actiniæ stand for a day or two in the dish, and then picking out the liveliest and handsomest, detach them once more from their hold, drop them into your vase, right them with a bit of stick, so that the sucking base is downwards, and leave them to themselves thenceforth.

*Actinia Dianthus** you may find adhering to fresh oysters in any dredger or trawler's skiff, a lengthened mass of olive, pale-rose, or snow-white jelly. The rose and the white are the more beautiful; the very maiden-queens of all the beautiful tribe. If you find one, clear the shell on which it grows of everything else (you may leave the oyster inside if you will), and watch it expand under water into a furbelowed flower, furred with innumerable delicate tentacula;† and, in the centre, a mouth of the most brilliant orange;

* On our shores it is rarely met with. It resembles *A. marginata* very closely.—Eds.
† See Gosse's Aquarium, Plate 5, p. 192.

altogether one of the loveliest gems, in the opinion of him who writes, with which it has pleased God to bedeck his lower world.

But you will want more than these anemones, both for your own amusement and the health of your tank. Microscopic animals will breed, and will also die; and you need for them such scavengers as our friend *Squinado*. Turn, then, a few stones which lie piled on each other at extreme low-water mark, and five minutes' search will give you the very animal you want,—a little crab, of a dingy russet above, and on the underside like smooth porcelain. His back is quite flat, and so are his large angular-fringed claws, which, when he folds them up, lie in the same plane with his shell, and fit neatly into its edges. Compact little rogue that he is, made especially for sideling in and out of cracks and crannies, he carries with him such an apparatus of combs and brushes as Isidor or Floris never dreamed of, with which he sweeps out of the sea-water at every moment shoals of minute animalcules, and sucks them into his tiny mouth. Mr. Gosse will tell you more of this marvel, in his Aquarium, p. 48.

Next, your sea-weeds, if they thrive as they ought to do, will sow their minute spores in millions around them; and these, as they vegetate, will form a green film on the inside of the glass, spoiling your prospect; you may rub it off for yourself, if you will, with a rag fastened to a stick, but if you wish at once to save yourself trouble, and to see how all emergencies in Nature are provided for, you will set three or four live shells to do it for you, and to keep your subaqueous lawn close mown.

That last word is no figure of speech. Look among the beds of sea-weed for a few of the bright-yellow or green sea-snails. For the present, they will only nibble the green ulvæ, but when the film of young weed begins to form, you will see it mown off every morning as fast as it grows, in little semicircular sweeps, just as if a fairy's scythe had been at work during the night.

And a scythe has been at work; none other than the tongue of the little shell-fish; a description of its extraordinary mechanism (too long to quote here, but which is well worth reading) may be found in Gosse's Aquarium, p. 34.

A prawn or two, and a few minute starfish, will make your aquarium complete; though you may add to it endlessly, as one glance at the salt-water tanks of the Zoölogical Gardens and the strange and beautiful forms which they contain, will prove to you sufficiently.

You have two more enemies to guard against, dust and heat. If the surface of the water becomes clogged with dust, the communication between it and the life-giving oxygen of the air is cut off; and then your animals are liable to die, for the very same reason that fish die in a pond which is long frozen over, unless a hole be broken in the ice to admit the air. You must guard against this by occasional stirring of the surface (it should be done once a day if possible), and by keeping on a cover. A piece of muslin tied over will do; but a better defence is a plate of glass, raised on wire some half-inch above the edge, so as to admit the air. I am not sure that a sheet of brown paper laid over the vase is not the best of all, because that, by its shade, also guards against the next evil, which is heat. Against that you must guard by putting a curtain of muslin or oiled paper between the vase and the sun, if it be very fierce, or simply (for simple expedients are best) by laying a handkerchief over it till the heat is past. But if you leave your vase in a sunny window long enough to let the water get tepid, all is over with your pets. Half an hour's boiling may frustrate the care of weeks. And yet, on the other hand, light you must have, and you can hardly have too much. Some animals certainly prefer shade, and hide in the darkest crannies; and for them, if your aquarium is large enough, you must provide shade, by arranging the bits of stone into piles and caverns. But without light, your sea-weeds will neither thrive, nor keep the water sweet. With plenty of light you will see,

to quote Mr. Gosse once more (p. 259), "thousands of tiny globules forming on every plant, and even all over the stones, where the infant vegetation is beginning to grow; and these globules presently rise in rapid succession to the surface all over the vessel, and this process goes on uninterruptedly as long as the rays of the sun are uninterrupted.

"Now these globules consist of *pure oxygen*, given out by the plants under the stimulus of light; and to this oxygen the animals in the tank owe their life. The difference between the profusion of oxygen-bubbles produced on a sunny day, and the paucity of those seen on a dark, cloudy day, or in a northern aspect, is very marked." Choose, therefore, a south or east window, but draw down the blind, or throw a handkerchief over all if the heat become fierce. The water should always feel cold to your hand, let the temperature be what it may.

Next, you must make up for evaporation by *fresh* water. A very little will suffice, as often as in summer you find the water in your vase sink below its original level, and prevent the water from getting too salt. For the salts, remember, do not evaporate with the water, and if you left the vase in the sun for a few weeks, it would become a mere brine-pan. —*From Kingsley's Glaucus, or the Wonders of the Shore.*

A FEW SEA-WORMS.

BY A. S. PACKARD, JR.

Our sea-side readers may simply shrug their shoulders in disgust at the prospect of becoming acquainted with creatures unfortunate enough to possess a few "poor relations," who have brought, either by their uncanny looks or disagreeable habits, disrepute upon the whole class of worms. We wish to put in a plea for the worm. Hear our evidence,

look at a few specimens of this much-abused race, hear the story of their life, their strange manner of increasing the annulate census, and judge, ye sea-side loiterers of the Worm's place in society. We are not levellers. A worms' a worm, a lobsters' a lobster, and a bees' a bee; and they are not convertible terms. The earth is made more beautiful by bees and the myriads of insects, for without their aid, as pollen gatherers, in fertilizing flowers and "setting" fruit, the world would be a poor sojourning place for that unsatisfied and uneasy animal who gives all other animals names. What would a fish-market be without lobsters and crabs, who, with their thousand allies, the shrimps, sea-fleas, and barnacles, are the scavengers of the sea? But with all these there is a void which worms can only fill. How could Old Neptune thrive without the Nereids, the Naides, and the Amphitrites to adorn his halls, deftly sweep the floors of his palaces, and in a thousand ways beautify and enrich his domain by their silent, unobtrusive ministry?

An hour's search among the tidal-pools and rocks at low-water mark, will give us ample material for a few moments' discourse. We turn over a stone half-buried in the mud, and in the wealth of life there sheltered, behold strange, crawling, leech-like worms, of livid flesh-color, or dark-green or blood-red, and usually long and narrow, and with the power of indefinitely extending their bodies when in search of food or actually taking it. There are various species of Flat-worms and Nemerteans which glide rapidly over the surface. They are smooth, round or flattened, pointed at each extremity, and it is with difficulty that the head can be distinguished from the tail, as the mouth is a minute slit on the under-side of the head, and the eye-specs (almost the simplest kind of eye known) are often absent. The body is not divided into joints, or rings, while it is capable of great extension. Charles Kingsley, in his "Glaucus, or the Wonders of the Shore," has graphically described this property in a Nemertean.

"There lies an animal as foul and monstrous to the eye as 'hydra, gorgon, or chimæra dire,' and yet so wondrously fitted to its work, that we must needs endure for our own instruction to handle and to look at it. Its name I know not (though it lurks here under every stone), and should be glad to know. It seems some very 'low' Ascarid or Planarian worm. You see it? That black, shiny, knotted lump among the gravel, small enough to be taken up in a dessert-spoon. Look now, as it is raised and its coils drawn out. Three feet—six—nine, at least; with a capability of seemingly endless expansion: a slimy tape of living caoutchouc, some eighth of an inch in diameter, a dark chocolate-black, with paler longitudinal lines. Is it alive? It hangs helpless and motionless, a mere velvet string across the hand. Ask the neighboring Annelids and the fry of the rock-fishes, or put it into a vase at home, and see. It lies motionless, trailing itself among the gravel; you cannot tell where it begins or ends; it may be a dead strip of sea-weed, *Himanthalia lorea* perhaps, or *Chorda filum;* or even a tarred string. So thinks the little fish who plays over and over it, till he touches at last what is too surely a head. In an instant a bell-shaped sucker mouth has fastened to his side. In another instant, from one lip, a concave double proboscis, just like a tapir's (another instance of the repetition of forms), has clasped him like a finger; and now begins the struggle: but in vain. He is being 'played' with such a fishing-line as the skill of a Wilson or a Stoddart never could invent; a living line, with elasticity beyond that of the most delicate fly-rod, which follows every lunge, shortening and lengthening, slipping and twining round every piece of gravel and stem of sea-weed, with a tiring drag such as no Highland wrist or step could ever bring to bear on salmon or on trout. The victim is tired now; and slowly, and yet dexterously, his blind assailant is feeling and shifting along his side, till he reaches one end of him; and then the black lips expand, and slowly and surely the curved finger begins

packing him end-foremost down into the gullet, where he sinks, inch by inch, till the swelling which marks his place is lost among the coils, and he is probably macerated to a pulp long before he has reached the opposite extremity of his cave of doom. Once safe down, the black murderer slowly contracts again into a knotted heap, and lies, like a boa with a stag inside him, motionless and blest."

But we will leave these lesser lights among creeping things and introduce to the reader a singular and beautiful creature (Fig. 1), which we first discovered just below low-water mark on the coast of Maine, but which has been found by some members of the Essex Institute on the piles of Beverly bridge, a rich hunting-ground for marine zoölogists. It is about an inch and a half long, rather stout in its proportions, and of a delicate pale-green mottled with a livid tint, and with irregularly scattered blackish dots and patches. When at rest, one might be readily excused if on a casual glance he should mistake the tail for the head, but when it glides slowly forwards, it protrudes a soft, somewhat irregularly conical head, which is capable of great extension, as at one moment it looks like nothing at all, and in less than another like a veritable head. Its eyes are little dark specs arranged in two ∧ shaped lines. A little behind the eyes are given off a great profusion of long hair-like feelers, which curl around, and, when at rest, almost completely envelope its whole body. When it moves, the long pale feelers, centred with a line of delicate red, drag along after it, and perhaps aid the worm in its very slow gliding motion.

Fig 1.

Another worm, quite interesting in its habits, is the Hæmatorrhæa, or Blood-drop. We found it in company with the preceding worm just below low-water mark.

While looking over the results of an hour's search among the Laminaria or Devil's Aprons, we noticed among the roots what was apparently a drop of blood. Placing it in a saucer, it soon moved and slowly stretched out a few feelers of unequal length, fastened the bulging ends in front of it, and thus anchored by the sucker-like swollen ends of the tentacles, drew itself along, slowly travelling around its prison. Our figure (2) represents it twice its natural size. The head and tentacles are of a paler red than the rest of the body, along each side of which is a row of short bristles, which aid it in moving in and out of its little rudely constructed tube of particles of sand, for we soon found, that, like the Terebella, it buried itself in the sand, leaving only the feelers exposed.

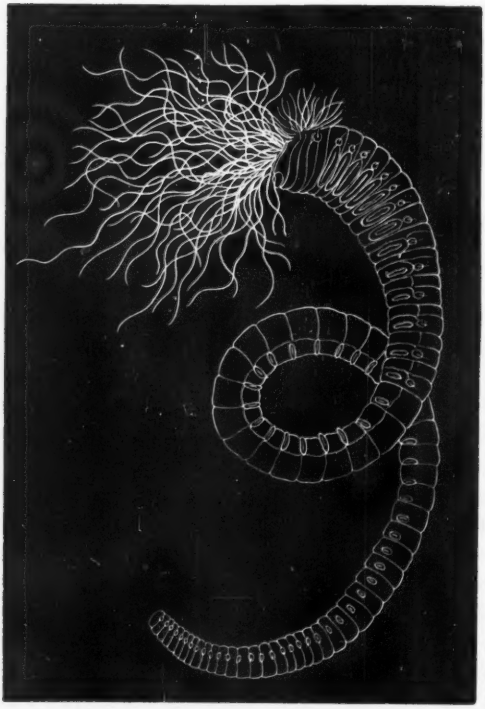
Fig. 2.

Many worms dwell in tubes, where their soft bodies are protected from prowling crabs and flesh-eating snails. Such are the Serpulas, which secrete a limestone shell fitting to the body, and usually curved like a ram's horn, while the tube of the Sabella, a beautiful worm, is leathery, or sometimes horny. An example of the latter is the case of a Spiochætopterus (if the reader will excuse the length of the name, no fault of the worm however), fragments of which we have dredged at a great depth, over fifty fathoms, in a deep fiord on the coast of Labrador, and which has been found on the coast of Norway by Professor M. Sars, over a foot in length and not a tenth of an inch in diameter. The *Amphitrite cirrata* (Fig. 3) is a curious tube-dweller. We have dredged it abundantly in the harbor of Eastport, Maine, that spot favored by fogs, cold storms, and icy sea-currents, where the temperature of the land and sea so nearly agree that low spring-tides reveal a wealth of life which in less-favored spots are hid far below low-water mark, and can be reached only by that uncertain means, the dredge.

Our figure, copied from Malmgren's (a Swedish naturalist) recent work on the worms of the Polar sea, relieves us from

giving a long description of this interesting worm. On being removed from its long flexible tube of mud, its thick body is seen to consist of seventy-five to eighty-five rings, with a profusion of long tentacles, and a mass of short branchiæ, or gills, behind the head; behind which is a short row of flattened tubercles, from each of which spring a fine bristle, that aids the animal in moving in and out of its case. There is also another row of flattened tubercles along the whole length of the body. These tubercles probably enable the animal to keep firmly within its tube, and when contracted allow it to move partially out of it.

Fig. 3.



We observed several tentacles which had been accidentally torn off, wriggling about the saucer as if actually living. Lewes (Sea-side Studies, p. 59) found that they retained the power of motion for six days. But should many of these feelers be cut off our Terebella, or Amphitrite, would soon be able to reproduce them, and not only this, but it has the

power, according to Lewes, of throwing off another individual like itself, by a process analogous to the budding of leaves on a plant. But let us hear Mr. Lewes himself speak:

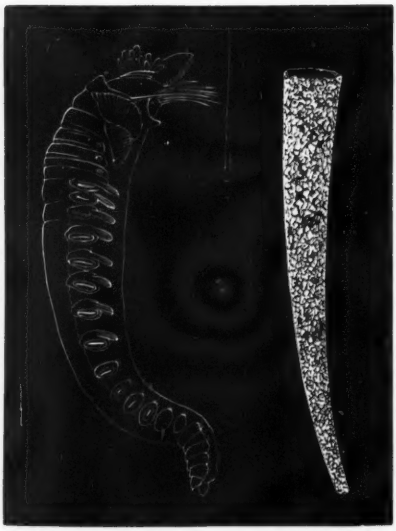
"No one, I believe, has yet recorded the fact of the Terebella multiplying itself by the process of gemmation, which is known to occur in the case of some other Annelids,—such as the *Nais*, the *Syllis*, and the *Myriana*.* When the animal reproduces by this budding process, it begins to form a second head near the extremity of its body. After this head other segments are in turn developed, the tail, or final segment, being the identical tail of the mother, but pushed forward by the young segments, and now belonging to the child, and only vicariously to the mother. In this state we have two worms and one tail. It is as if a head were suddenly to be developed out of your lumbar vertebræ, yet still remain attached to the column, and thus produce a double-headed monster, more fantastic than fable. Or suppose you were to cut a caterpillar in half, fashion a head for the tail half, and then fasten this head to the cut end of the other half,—this would give you an image of the Syllis budding. But in some worms the process does not stop here. What the mother did, the child does, and you may see at last six worms forming one continuous line, with only one tail for the six. The tail indeed is the family inheritance; but reversing the laws of primogeniture, it always descends to the youngest. Such, in a few words, is the budding of annelids. I omit differences, and many curious details, only desiring to fix the reader's attention on the cardinal fact. The separation finally takes place, and then we perceive the children and grandchildren are not quite the same as their ancestor. The fact has not been observed at all hitherto in the group of annelids named *Tubicola;* yet two of my *Terebellæ* gave me a sight of it. The first died before the separation took place. The second, after a day or two's

*For an account of this mode of reproduction in worms, see Clark's "Mind in Nature," published by D. Appleton & Co., New York.

captivity, separated itself from its appendix of a baby, and seemed all the livelier for the loss of a juvenile which had been literally in that condition of 'hanging to its mother's tail,' which I have heard applied in metaphorical sarcasm to small boys anxious to be with their mothers. The young one only lived four days."

Another tube-dweller is the Pectinaria (Fig. 4, *Pectinaria hyperborea* of Malmgren, and its slightly curved conical tube), which is found on our coast in deep water, and its empty tube sometimes at low water. So far as we are aware it does not protrude far out of its tube, but only exhibits a few short tentacles and a pair of the most brilliant comb-like set of golden bristles, from twelve to fourteen in each set. It is from one to two inches long, and its slightly curved tube is made up of little particles of sand so arranged as to present a smooth, almost shining, surface both within and without. We have dredged this species most abundantly in deep, quiet, muddy bays, where it feeds on fish-offal thrown from the fishing vessels. It grows of a smaller size southward, and is scarcely as common on our shores as in the arctic seas.

Fig. 4.



But the most brilliant and gorgeous sea-worms are the Nereids. Dig down a few inches into the mud between tide-mark and you will speedily turn up the *Nereis denticulata* of

Stimpson, a common worm on our shores. In this worm the head is larger and more distinctly separated from the rest of the body than in the others we have mentioned, and it is provided with two pairs of eyes and six or eight pairs of tentacles, while along each side of the body is a row of oar-like feet, expanding above into broad, oar-like, swimming organs, and furnished beneath with several bristles and fleshy filaments like feelers. The whole worm is radiant with all the colors of the rainbow reflected from its pearly body.

Some of these Nereids are of enormous size. We have found in the Bay of Fundy portions of the *Nereis grandis* of Stimpson, which is seventeen inches in length, and an allied form (*Eunice gigantea* Cuvier) grows in the Indian Ocean to a length of over four feet. These are the princes among worms, ranking above the smaller forms by their superior size and organization, and their rich imperial dress.

REVIEWS.

GOOD BOOKS FOR THE SEA-SIDE. — We cannot better close our sea-side number of the NATURALIST than by enumerating a few books on the common objects of the sea-side. We regret that more has not been done for the amateur sea-side naturalist by American writers. The shells of the shores of New England have been described by the late Dr. Gould in his Invertebrates of Massachusetts, originally published by the State, of which there is a new edition in preparation, to be illustrated with an abundance of first-class wood engravings, and several lithographic plates. It is to be hoped that the Legislature will see fit to order a large edition to be printed, as we learn the work is not to be stereotyped, and is not to be placed on sale, public libraries only being supplied. Otherwise, the book will not fall into the hands of naturalists, the future generations of which will be numbered by thousands, where they can now be counted by the hundred. The publication of Harris's Injurious Insects, which was stereotyped and is now rapidly selling, several editions having been struck off, was of incalculable advantage to the State from an educational point of view, and the stereotyping of the new edition of Gould's Invertebrates is a public necessity. If each legislator is to have a copy

free gratis, pray why may not naturalists have the right to pay $5, or whatever the price may be, for a copy?

Our only truly popular book is "A First Lesson in Natural History, by Actæa," prepared under the direction of Professor Agassiz, and illustrated with numerous wood-cuts. Within a compass of eighty-two pages are pleasant talks about Sea-anemonies and Corals, Coral Reefs, Hydroids and Jelly-fishes, Starfishes and Sea-urchins. A more solid book and full of scientific novelties is Mrs. E. R. and Mr. A. Agassiz' Sea-side Studies, a beautifully printed and illustrated work on Hydroids and Jelly-fishes,—an indispensable hand-book to those beautiful forms. These two works form a fitting introduction to the four volumes of Professor Agassiz' great work on the Natural History of the United States, the third and fourth volumes of which are on the radiated animals of our coast, mostly comprising the Polyps and Jelly-fishes.

Many of these and other marine animals are described in Professor Clark's "Mind in Nature," a work which every student of nature should read. It contains many illustrations drawn by the facile pencil of the author. Professor Tenney's "Zoölogy for Schools" contains many admirable wood-cuts of our common fishes and marine animals, and this work must go into the library of the sea-side tourist. The student of marine zoölogy cannot do without Dr. Stimpson's Marine Invertebrates of Grand Menan (an island lying at the mouth of the Bay of Fundy), which was published by the Smithsonian Institution, whose Contributions to Science also contain Harvey's great work on the Sea-weeds of North America, abundantly illustrated with colored plates representing our marine flora. Numerous other papers on sea-animals are scattered through the Proceedings and Memoirs of our scientific societies, especially those of Charleston, Philadelphia, New York, New Haven, Boston, Salem, and Portland. The Illustrated Catalogues and Bulletins of the Museum of Comparative Zoölogy at Cambridge, are also invaluable to those who wish to study these animals more thoroughly.

In lieu of popular American books there are several English works to be recommended. The animals they describe resemble ours in habits, and though differing specifically from those of our coast, these books will fill an important vacancy in our sea-side literature. "First and foremost, certainly," writes Charles Kingsley, come Mr. Gosse's books:

"There is a playful and genial spirit in them, a brilliant power of word-painting, combined with deep and earnest religious feeling, which makes them as morally valuable as they are intellectually interesting. Since White's 'History of Selborne,' few or no writers on Natural History, save Mr. Gosse and poor Mr. E. Forbes, have had the power of bringing out the human side of science, and giving to seemingly dry disquisitions and animals of the lowest type, by little touches of pathos and humor, that living and personal interest, to bestow which is generally the special function of the poet: not that Waterton and Jesse are not excellent in this respect, and authors who should be in every boy's library: but they are rather anecdotists than systematic or scientific inquirers; while Mr. Gosse, in his 'Naturalist on the Shores of Devon,' his 'Tour in Jamaica,' and his 'Canadian Naturalist,' has done for those three places what White did for Selborne, with all the improved appliances of a science which has widened and deepened tenfold since White's time.

"Miss Anne Pratt's 'Things of the Sea-coast' is excellent; and still better is Professor Har-

vey's 'Sea-side Book,' of which it is impossible to speak too highly; and most pleasant it is to see a man of genius and learning thus gathering the bloom of his varied knowledge, to put it into a form equally suited to a child and to a *savant*. Seldom, perhaps, has there been a little book in which so vast a quantity of facts has been compressed into so small a space, and yet told so gracefully, simply, without a taint of pedantry or cumbrousness,—an excellence which is the sure and only mark of a perfect mastery of the subject.

"Two little 'Popular' Histories, one of British Zoophytes, the other of British Sea-weeds, by Dr. Landsborough, are very excellent; and are furnished, too, with well-drawn and colored plates, for the comfort of those to whom a scientific nomenclature (as liable as any other human thing to be faulty and obscure) conveys but a vague conception of the objects. These may serve well for the beginner, as introductions to Professor Harvey's large work on the British Algæ, and to the new edition of Professor Johnston's invaluable British Zoophytes."

To these we may add "Quatrefages' Souveniers of a Naturalist," a fascinating work by a first-class observer, on the animals of the coast of France and of the shores of the Mediterranean, republished in London.

NATURAL HISTORY MISCELLANY.

ZOÖLOGY.

INSECTS LIVING IN THE SEA.—Insects are essentially earth-inhabiting. A small proportion of all the insects live in fresh water, and less than a hundred are known to inhabit the sea. Only three species are known to inhabit the sea in this country. A year ago in August, while dredging in Salem harbor, we detected the larvæ of a species of fly living on the floating eel-grass, and apparently living on the vegetable matter collected on

Fig. 1*a*. Fig. 1

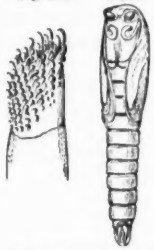


Fig. 2.

it The twentieth of September they transformed to pupæ (Fig. 1; 1*a*, forefoot of the larva), and on the ninth of October appeared the fly (Fig. 2, male, and beneath, head of the female with simple antennæ), the male of which has beautifully pectinated antennæ, and belongs to the genus *Chironomus*. We have since found the full-grown

larva living in abundance at low-water mark among the green sea-weeds late in April. They must have hatched from eggs laid in the autumn.

Another insect (Fig. 3) we have found late in April at low-water mark, in Casco Bay, Maine, and, like the Chironomus, living in the green sea-weed. It is, probably, the larva of some Rove-beetle (*Staphylinus*), and as suggested to us by Dr. Stimpson, is, perhaps, the larva of *Micralymma*, a beetle known in Europe to inhabit the sea.

Fig. 4.

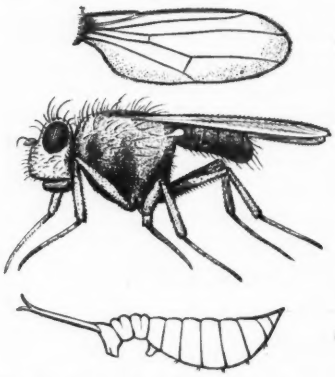


Fig. 3.

In this connection we figure the brine-inhabiting Ephydra (Fig. 4, side-view of the fly; 4*a*, wing; 4*b*, side-view of the puparium or pupa-case), which, according to Mr. E. T. Cox, from whom we have received specimens, lives in the very strong brine of the "Graduation House," at the Equality Salt-works, Gallatin County, Illinois. Dr. T. d'Oremieulx has sent us a puparium hardly distinguishable from the Illinois one, which he collected under the sea-weed on the shores of Narragansett Bay; so that we have here another sea-inhabiting insect.

Fig. 5.

We figure (5) the pupa of *Eristalis*, or Rat-tailed fly, which is found with the Ephydra, at the Equality Salt-works. Mr. Horace Mann has found immense numbers of a similar insect in the briny waters of Mono lake, California, and it is not improbable that some of these curious flies will be found to inhabit our shores between tide-marks. — A. S. P.

Directions for collecting the Lower Forms of Marine Animals. — The collector must be acquainted with the fact that the sea has distinct zones of animal and plant-life. Thus, between high and low-water-mark certain species occur. From low-water mark to fifteen fathoms, another set is found peculiar to that zone. Beyond these depths other zones occur. In collecting between high and low-water mark, the collector must visit the different kinds of shores. Thus on a rocky and exposed shore, particular attention must be paid to the pools left by the tide; those nearest low-water mark will always be found the richest. Having selected a proper pool for examination, let him lie down flat upon the rocks, first taking a survey of the pool before disturbing it. Having observed or collected what free swimming animals he chooses, he may then lift carefully (in order not to rile the water), one by one, the

loose fragments of rocks that possibly cover the bottom, and examine their lower surfaces. Here he will find many curious and interesting shells, some of them minute; the brittle starfish, several kinds of worms, and above all those elegant sea-slugs, little animals closely allied to the snail, only having no shell. Many other forms will be found in such haunts by careful searching. On these rocky shores the collector should take advantage of the low spring and fall tides, for then a portion of another zone of animal life will be exposed to him, and he will find many novelties. Never leave a stone unturned in such places, for marine animals are proverbially shy, and prefer seclusion. He must also take advantage of the heavy storms that beat upon the coast, and along the beaches after one of these storms he may pick up many rarities. In fact he may find certain species washed up in the greatest profusion, that he will rarely meet with at other times. The long mud-flats will repay him a muddy tramp at low water, for, crawling over the mud, or buried just beneath its surface, he will find certain mollusks and worms peculiar to such places.

One of the richest fields for collecting near cities will be found on the piles of any exposed pier, or bridge. We mean by exposure, a structure that stands in deep water where the ocean has more or less direct access to it, protected at the same time from the heavy wash of the sea by some outlying island or cape. Let him take a small boat, and, armed with a net having a stout wire frame affixed to a pole ten feet long, he may drag up at low tide from the sides of the piles by a slow raking motion, a perfect harvest of sea-anemones, sea-urchins, starfishes, shells, crabs, worms, and a legion of other forms that will keep him busy for some time.

An outfit for a collector is, first of all, a basketful of wide-mouthed bottles, pickle jars will answer the purpose, a pair of forceps, a good pocket lens, unless he carries it in his head, a case-knife to detach certain animals from the rocks; a few little pocket vials will not come amiss. For collecting animals beyond the limits described, the collector must possess a dredge, the simplest form of which is a triangle made of iron; the longest side sharpened on one edge to act as a scraper. To this iron a bag of netting is affixed. Supplied with a good manilla rope, he may dredge to the extent of his line, and the assemblage of animals will be quite unlike those that he has met with in the zones mentioned above.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Society of Natural History, *Portland, Me., May* 7.—The rare shell, *Helix multidentata*, before known only by a few specimens, was reported as occurring abundantly in a wood on Cape Elizabeth. The most inter-

esting event of the meeting was the presentation of a Pteropod (*Clione borealis*), a marine animal of the arctic seas, which has been discovered by Mr. C. B. Fuller in large quantities in our harbor. This animal belongs to a division of the Mollusca called Pteropoda, or "Wing-foot," from the swimming appendages which resemble the organs of flight of birds. Only six species are known to occur on the coast from the arctic seas to Georgia. They are most abundant in the extreme northern or southern oceans. Some possess a delicate glassy or horny shell, while Clione is entirely naked, and of a consistency not much greater than that of the common jelly-fish. It is a very singular sight to observe their evolutions in a jar of sea-water. The Clione moves with a deliberate and graceful motion of its wings — almost recalling the action of a dexterous human swimmer. The Limacina, another pteropod observed by Mr. Fuller, and collected with the Clione, uses its wings much more nervously, and gambols about the jar like a miniature and half-fledged robin.

It is not known that the Clione has ever been seen so far to the southward before. Packard reports it as abundant on the coast of Labrador. This is probably the extreme southern limit of the species, and we are no doubt indebted to the persistency of our "cold term" for these fairy-like visitors in our harbor. Is our climate so changing its temperate quality that arctic animals find in our waters a congenial home?

American Association for the Advancement of Science. — The next meeting will be held at Chicago the last of August. It promises to be an unusually interesting meeting, and we hope it will be largely attended. Various excursions by the members are contemplated, of which, however, we have not received precise information in time to insert in this number.

CORRESPONDENCE.

R. H. F., Mt. Etna, Ind. — The plant you send appears to be the *Lemna*, or Duckweed.

W. V. A., New York. — The solvent for reeling the cocoons of the Cynthia Silk-moth, given by Guèrin Menneville, is: some carbonate of potash in boiling water, with an addition of white soap; no proportions given. — L. T.

E. O., Yellow Springs, O. — You write that "we are enjoying a visitation of the seventeen-year locust. The first perfect insect appeared on May 18th. The ground is full of the larvæ." We would be greatly obliged for branches of the oak showing the mode of laying the eggs, and for alcoholic specimens of the larvæ of different sizes, and of the pupa and adult. We can name a few of the beetles you send now, and will send you the names of the others in a few weeks. 1. *Nebria pallipes*; 3. *Pangus caliginosus*; 4. *Dicælus purpuratus*; 5. *Ochthedromus antiquus*; 13.? *Clivina pustulata*; 16. *Poecilus chalcites*; 18. *Harpalus* near *amputatus* Say; 20. *Oiceoptoma marginata*; 22. *Silpha inequalis*; 24. *Staphylinus villosus*.

BOOKS RECEIVED.

Quelques Remarques sur la Geographie et les Monuments du Péron. Par E. G. Squier. Paris, 1868. 8vo, pp. 28.

The Butterflies of North America, with Colored Drawings and Descriptions. By Wm. H. Edwards. Philadelphia. Part I. April, 1868. 4to, with five plates, $2.00.

Cosmos. April 18, May 9, 16. Paris.

Land and Water. April 4, 11, 18. London.

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Entomologist's Monthly Magazine. June to December, 1866, 1867, January to March, 1868. London.